MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
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SRM Number: 3164
MSDS Number: 3164
SRM Name: Uranium Standard Solution

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Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of uranium. One unit of SRM 3164 consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of uranium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Uranium Standard Solution

Other Designations:

Uranium: U; elemental uranium; uranium metal.
Uranium Nitrate: Nitric acid, uranium salt; uranium tetranitrate; uranium (IV) nitrate.
Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Uranyl Nitrate	10102-06-4	233-266-3	1.7
Uranium	7440-61-1	231-170-6	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 3

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed trough the skin. Uranium compounds are radioactive; uranium nitrate is also highly toxic by ingestion or inhalation.

Physical Hazards: **SRM 3164 is a limited quantity radioactive material that is exempt from radioactive labeling requirements under 49CFR section 173.421. The massic activity of SRM 3164 is less than 500 Bq/g**.

Potential Health Effects

Inhalation: Nitric acid, if inhaled, can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Inhalation of uranium or uranyl nitrate may increase the risk of cancer, birth defects, or reproductive damage.

Skin Contact: Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Contact with uranium or uranyl nitrate may cause skin irritation and dermatitis.

Eye Contact: Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Contact with uranium or uranium nitrate may cause eye irritation, conjunctivitis, and/or keratitis.

Ingestion: Nitric acid can cause severe burns and damage to the gastrointestinal tract. Repeated or prolonged exposure to uranium or its compounds may affect blood formation, disrupt the nervous and reticuloendothelial systems, and damage the lungs, liver, and kidneys. Uranyl nitrate may increase the risk of birth defects, or reproductive damage.

Medical Conditions Aggravated by Exposure: The mixture and its components may aggravate disorders of the eyes, skin, respiratory tract, and liver.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In The National Toxicology Program (NTP) Report on Carcinogens		X
In The International Agency for Research on Cancer (IARC) Monographs		X
By The Occupational Safety and Health Administration (OSHA)		X

Note: Although elemental uranium and uranyl nitrate are not classified as carcinogens, both materials are mildly radioactive, and prolonged exposure may be associated with an increased risk of cancer.

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. **DO NOT** give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: No data are available for this mixture. The behavior of the solution may differ from that of the individual components. Nitric acid and uranyl nitrate are oxidizers that can react with combustible materials to cause fires.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. A water spray may be used to cool exposed containers to prevent rupture. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (Volume %): N/A

Upper Explosive Limit(Volume %) : N/A

Flammability Class (OSHA): N/A

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction. Since the components of this mixture (uranium and uranyl) are mildly radioactive materials, spills must be handled and reported as radioactive waste (CFR Title 10).

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TWA: 2 ppm or 5 mg/m^3
OSHA TWA: 2 ppm or 5 mg/m^3

Uranyl Nitrate: No TLV has been established for this solution. Limits for total dust, nuisance dust, or particulates not otherwise classified:

ACGIH TWA: 0.2 mg/m^3
OSHA TWA: 0.05 mg/m^3

Uranium: No TLV has been established for this solution. Limits for total dust, nuisance dust, or particulates not otherwise classified:

ACGIH TWA: 0.2 mg/m^3
OSHA TWA: 0.25 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to The ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to The NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Uranyl Nitrate	Uranium
Appearance and Odor: colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** yellow crystals with no odor	**Appearance and Odor:** gray to white, lustrous solid
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 394.2	**Relative Molecular Weight:** 238
Molecular Formula: HNO_3	**Molecular Formula:** $(UO_2)(NO_3)_2$	**Molecular Formula:** U
Specific Gravity: 1.05	**Specific Gravity:** 2.8	**Specific Gravity:** 19
Solvent Solubility: decomposes in alcohol	**Solvent Solubility:** soluble in alcohol, ether	**Solvent Solubility:** soluble in acetone and acids; insoluble in alkali and alcohol
Water Solubility: soluble	**Water Solubility:** 67 %	**Water Solubility:** insoluble

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of uranium and nitric acid. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Heat, ignition sources, and incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Uranyl Nitrate: Incompatible with combustible materials (may ignite or explode) and reducing agents.

Uranium: Incompatible with oxidizing materials, halogens, metals, bases, halo carbons, acids.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: When heated, nitric acid may produce toxic mist or vapor and nitrogen oxides (NO, NO_2, N_2O). Uranyl nitrate may produce nitrogen oxides.

Hazardous Polymerization: ____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human-oral LD_{Lo}: 430 mg/kg
Rat-inhalation LC_{50}: 130 mg/m^3 (4 hrs)

Uranyl Nitrate: No toxicological data available for the identified solution.

Uranium: No toxicological data available for the identified solution.

Target Organ(s): Skin, eyes, respiratory tract, GI tract, central nervous system, bones, bone marrow, lymphatic system, liver, kidneys, testes.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen and reproductive effector. Uranyl nitrate and uranium have been investigated as reproductive effectors. Uranium and its compounds should be treated as potential mutagens and carcinogens.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Fish Toxicity (LC_{50}): 2.8 µg/L (96 hr)

Uranyl Nitrate, Ecotoxicity Data:

Fish Toxicity (LC_{50}): 3100 µg/L (96 hr)

Uranium: No ecotoxicity data were found for elemental uranium.

Environmental Summary: This mixture and some or all of its components are toxic to aquatic organisms. **DO NOT** release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Uranium and its compounds must be disposed of as radioactive waste (CFR Title 10). Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lb.
Uranium Nitrate: RQ = 100 lb.
Uranium: RQ = 1000 lb.

SARA Title III Section 302: Nitric acid is regulated

SARA Title III Section 304: Nitric acid is regulated

SARA Title III Section 313: Nitric acid and uranyl nitrate (N511, Nitrate Compounds) are regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material).

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Uranyl Nitrate: T^+ (Very Toxic).
Uranium: T^+ (Very Toxic).

Risk Phrases (mixture):

R23	(toxic by inhalation)
R25	(toxic if swallowed)
R34	(causes burns)
R36/37/38	(irritating to eyes, respiratory system and skin)
R48	(dangerous of serious damage to health by prolonged exposure)

Safety Phrases (mixture):

S20/21	(when using, do not eat, drink or smoke)
S28	(wash after contact with skin)
S45	(in case of accident or illness, see doctor; show label)
S60	(dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All three components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources: MDL Information Systems, Inc., MSDS *Nitric Acid Solutions*, 16 March 2006.
MDL Information Systems, Inc., MSDS *Uranyl Nitrate*, 16 June 2005.
MDL Information Systems, Inc., MSDS *Uranium*, 16 March 2006.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in thee NIST Certificate of Analysis.